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Deterrence and Origin of Legal System: Evidence from 1950–1999

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This article offers evidence on legal systems' detterrence of acts that may cause harm, which extends law-and-finance literature comparing common law and civil code systems. Fatality rates from two causes are used to gauge deterrence: (1) motor vehicle accidents and (2) accidents other than motor vehicle. Both vary significantly across countries classified by origin of legal system. The data cover 50 years, offering evidence on evolution of differences over time. Findings for accidents other than motor vehicle are evidence on legal system flexibility, as the diffuse set of causes increases the difficulty of specifying harmful actions ex ante.

1. Introduction

A large and growing body of empirical evidence supports a belief that features of a country's culture, especially its legal system, affect the development of its financial markets. Prominent in this stream of evidence is a

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series of articles by Rafael La Porta, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny (1997, 1998, 2000), which supports a law-and-finance theory explaining why financial markets of some countries are larger than others. These studies document the effects of protection—protection offered by a country's legal system to investors—against expropriation by managers and controlling shareholders; they show how this type of protection affects the development of financial markets and ultimately economic growth.

The law-and-finance theory attributes much of the differences in investor protection to origins of countries' legal systems, as classified into four legal families: French, German, and Scandinavian civil code systems; and a fourth based on English common law. La Porta et al. find that common law countries offer the strongest and the French civil law countries offer the weakest protection of shareholder and creditor rights, with the Scandinavian and German civil code countries falling between. La Porta et al. find ownership of corporations to be more concentrated in countries whose legal systems offer poor investor protection, the concentrated ownership offering another mechanism for protecting owners against expropriation. As a result, the value of private corporate control rights is larger in a weak-protection environment than it would be in a legal environment offering stronger protection. La Porta et al. also find significantly smaller debt and equity markets in countries offering poor investor protection, which is evidence that strong legal protection for investors fosters the development of financial markets.

This article examines whether effects of a country's legal system extend beyond protection of shareholders against expropriation, possibly deterring other types of harmful acts, as well. Legal scholars recognize deterrence as a fundamental objective of tort rules and especially common law tort systems. Common law rules of liability impose on injurers the costs of injuries from negligent acts, in theory causing the injurer to weigh expected costs of accidents against benefits of investment in accident prevention. Posner's (1972) contribution to the law-and-economics literature argues that these rules create incentives for optimal investment in accident prevention, finding evidence to support this theory in a sample of 1,528 American appellate courts cases from the period 1875–1905. Posner's seminal contribution prompted a stream of research on deterrence incentives that parallels the more recent literature in law and finance.

Deterrence and other aims of tort law systems are summarized in Speiser, Krause and Gans (1983, pp. 12–13, 108–113); Goldberg (2003b, especially sections I and IV); and Shavell (2004). Shavell's analysis also considers possible deterrence effects of nonmonetary sanctions such as imprisonment. Empirical tests and analysis in the law-and-economics literature have produced mixed results on the magnitude of deterrence effects, with estimated effects varying by area of potential liability. Dewees, Duff, and Trebilcock (1996) analyze a large body of research in five areas of tort liability in the United States and Canada.[1] They conclude that deterrence effects seem strongest for automobile accidents and weakest for environmentally related accidents, but generally not strong enough to overcome defects they identify in the tort system. Sloan et al. (2000) reach an opposite conclusion with respect to the liability of commercial servers of alcoholic beverages, citing studies including their own showing that imposition of liability on servers consistently reduces fatalities from alcohol-related motor vehicle accidents.

The issue of possible deterrence effects of tort liability rules arose frequently in debates on no-fault automobile injury compensation systems in the U.S. and Canada (e.g., Boyer and Dionne, 1987; Kochanowski and Young, 1985). The enactment of no-fault systems in many states of the U.S., as well as in other countries, led to empirical tests for deterrence effects under tort systems. Typically, these studies used motor vehicle accident fatality rates to gauge deterrence effects. Tests in early studies produced mixed results, but later studies typically find that adoption of no-fault rules to replace common law tort liability leads to an increase in automobile accident fatality rates (e.g., Cohen and Dehejia, 2004; Cummins, Phillips, and Weiss, 2001). Cohen and Dehejia's estimates also take into account the effect of compulsory insurance requirements that typically accompany no-fault.

This article follows the pattern in these no-fault studies by using fatality rates as a gauge of deterrence incentives. Empirical tests presented in section 4 are based on fatalities by cause of death as extracted from the

1. The five areas are automobile accidents, medical accidents, product-related accidents, environmental injuries, and work-related injuries. Basing analysis on objectives of optimal compensation and corrective justice, as well as deterrence incentives, Dewees, Duff, and Trebilcock (1996) advocate other compensation systems to replace tort liability rules.

World Health Organization mortality database, which offers data from 113 countries across the 50 years 1950–1999. The long period of time covered by these data provides an opportunity to examine not only differences between legal systems, but also the evolution of these differences over time. The tests focus on the question of whether fatality rates from accidents are related to countries' legal systems, using data on two categories: motor vehicle accidents and accidents other than motor vehicle. Summarized briefly, the test results show that fatality rates differ significantly between groups of countries classified by origin of legal system, with some comparisons depending on the time period and cause of fatality. The test results confirm the presence of deterrence effects in common law tort systems, effects noted in studies of no-fault statutes, extending this finding into an international comparison across countries classified by origin of legal system. By showing that the origin of a country's legal system has effects extending beyond the development of financial markets, these results offer a bridge between studies of no-fault statutes and the law-and-finance literature.

Countries whose legal systems are based on English common law have motor vehicle accident fatality rates that have fallen below those in countries using French civil code systems or former members of the Soviet Union and Eastern Bloc countries; early in the period, they fell below those in German civil code systems, as well. Motor vehicle accident fatality rates in countries whose legal systems are based on Scandinavian civil codes do not differ significantly from those in common law countries. For accidents other than motor vehicle, fatality rates under common law systems have evolved to become lower than those under every type of civil code system: fatality rates from these accidents are lowest in countries whose legal systems are based on English common law, followed by French, then German, and then Scandinavian civil code countries, with the highest fatality rates occurring in former members of the Soviet Union and Eastern Bloc countries. This pattern of comparisons is consistent with a growing body of evidence on the adaptability and flexibility of common law systems and effects of judicial independence, but does not necessarily rule out other explanations.

Section 2 offers a framework for considering the results of empirical tests by discussing possible mechanisms for creating deterrence incentives, citing background material in the law-and-economics literature, and

reviewing differences between civil code and common law systems. Section 3 describes data sources and methodology, with results appearing in section 4. Section 5 concludes by discussing the pattern of observed differences between civil code and common law systems.

2. Deterrence Incentives from Specific Laws and Regulations, or Legal System Adaptability and Flexibility

Incentives against acts that may cause harm can be created by specific laws and regulations or may spring from other aspects of a country's legal system or its culture. The design of empirical tests to disentangle effects from these sources is not straightforward. Civil code systems typically rely on specific laws and regulations to shape behavior, but laws and regulations are important in common law systems, as well. The presence of specific laws and regulations is observable and, at least in theory, directly testable, but interpretation of such tests becomes clouded by recognition that laws and regulations themselves are a product of legal and political forces within the culture that may have other indirect effects. If courts and enforcement under civil code and common law systems are equally effective, a law or regulation that offers protection under one type of system should offer the same level of protection if grafted into the other. In the law-and-finance literature, La Porta et al.'s (1998) empirical evidence on German and Scandinavian civil law systems supports this idea by showing that these civil law systems protect investors about as well as common law systems.

Further, evidence on the presence of specific protective regulations can be ambiguous. Such evidence could be interpreted as showing a cultural attitude favoring strong protection or might just as well be interpreted as evidence that incentives within the legal system otherwise are too weak to provide meaningful deterrence.[2] La Porta et al.'s tests on specific

2. Mattiacci's (2003) survey of literature on economic incentives created by tort law and systems for allocating liability argues that civil law systems impose criminal sanctions or administrative penalties if their tort rules allow persons to less than fully internalize expected injury costs when they contemplate actions that might harm others. Less than full internalization of injury costs could occur where compensation does not consider aspects of injury whose costs are difficult to estimate or where the injuring party can escape being found liable. According to Mattiacci, punitive damages serve a similar purpose under the U.S. legal system.

regulations protecting investors reinforce other tests on legal system effects, which in this instance is consistent with these regulations being evidence of a cultural attitude favoring strong protection. Another approach to resolving this ambiguity would be to test for legal system effects after controlling for effects of specific regulations. Without standardized legislation, however, a cross-cultural comparison of specific regulations would encounter significant obstacles when it considered issues such as enforcement and possible sanctions. As a consequence of these issues, tests for the mechanism offering protection against harmful acts are likely to rely on indirect evidence rather than on direct tests.

A relatively recent body of research exemplified by Pistor and Xu's (2003) essay on fiduciary responsibility focuses on adaptability and flexibility of legal systems. Pistor and Xu argue that socioeconomic and technological changes continuously challenge the meaning and scope of law in areas such as fiduciary responsibility, making law in these areas necessarily incomplete. The problem is that lawmakers cannot anticipate future contingencies and circumstances in which the law of fiduciary responsibility might apply. As a consequence of this uncertainty, lawmaking and law enforcement powers (LMLEP) may be vested in courts or regulators. Under common law systems, courts typically have the flexibility to interpret concepts of fiduciary responsibility as they might apply to circumstances in a particular factual situation, unless these powers are restricted by legislation. Courts in civil law systems typically have less flexibility, being bound by more rigid statutory rules. Pistor and Xu identify three characteristics of an area of law affecting the allocation of LMLEP: the degree of incompleteness, the ability to specify harmful actions ex ante, and the level and scope of possible harm. They apply this framework to the area of fiduciary responsibility to conclude that courts are optimal holders of LMLEP in this area of law.

Concepts of flexibility and adaptability in legal systems underlie empirical tests employed by Beck, Demirgüç-Kunt, and Levine (2003, 2005). Their earlier article evaluates mechanisms that can explain the linkage between legal system and development of financial markets, while the later article evaluates mechanisms that can explain obstacles to firms' obtaining access to external financing. Both articles include a comparison of countries whose legal systems are based on English common law to countries whose legal systems are based on French civil codes, finding that

common law systems are more adaptable, have higher levels of judicial independence, lead to higher levels of financial development, and are associated with fewer obstacles to external financing.

Beck, Demirgüç-Kunt, and Levine examine the interrelationship of these findings by testing an "adaptability" theory against an alternative, which in the earlier article is "political channels" and in the later article is "political independence of judiciary." Either theory could explain why some legal systems foster the development of financial markets; adaptability stresses a legal system's ability to evolve with changing conditions, whereas political channels or independence of judiciary theories stress protection of property rights, particularly against government encroachment.[3] Adaptability reduces the gap between private contracting needs and the legal system's capabilities, while weak protection of private property rights hinders development of financial markets. Although the explanations are not mutually exclusive, the evidence evaluated by Beck, Demirgüç-Kunt, and Levine more strongly favors adaptability as the mechanism fostering financial development and reducing obstacles to external finance.

Much of the adaptability and flexibility of common law systems can be explained by the process through which courts develop rules of law. Three distinctive features of common law systems contribute to this flexibility: (1) judicial discretion, (2) the jury trial option, and (3) the standard of proof in civil cases. A brief review of these features helps explain how they could affect incentives against acts that might harm others, whether by discouraging expropriation of investors, or deterring other types of possibly harmful acts. Pistor and Xu's observations on adaptability and flexibility of legal systems imply that these features are likely to help create deterrence against harmful acts where the process leading to damage is not understood well enough to be incorporated into specific legislation.

Judicial discretion is an important distinguishing feature of common law systems, one that the law-and-finance literature has found important

3. Both studies use similar measures to evaluate adaptability, political channels, and independence of judiciary. One evaluates adaptability by considering whether judicial decisions are a source of law and whether judicial processes are based on principles of equity rather than purely on statutory law and legal formalities. Political channels and judicial independence are evaluated with reference to the degree of tenure of Supreme Court juctices and extent to which the Supreme Court has jurisdiction over cases involving the government.

in protecting investors. La Porta et al. (2000) acknowledge this issue by arguing that judicial discretion in deciding matters of fairness and self-dealing can be important in limiting expropriation of investors. Mahoney (2001) develops a rationale for the importance of judicial discretion in this area, using observations of Hayek (1960) to argue that judicial independence under common law systems allows for stronger enforcement of property and contract rights, which in turn speeds economic growth. Hayek had argued that French civil law systems emphasize the government's freedom to pursue collective goals, an idea rejected by common law systems in favor of freedom for individuals to pursue their own ends. These philosophical differences result in legal systems based on the French civil law allowing a larger role for the state and emphasizing collective over individual rights, which results in a subordinate role for the judiciary and fewer checks on government interference in private contracts.

Mahoney also observes that German and Scandinavian civil law systems differ from the French system, most notably in the level of independence for the judiciary under German systems. Mahoney's research does not pursue this distinction in empirical tests, because of the relatively few countries adopting the German and Scandinavian systems. Later, Klerman and Mahoney (2005) test for the effects of the English judiciary's gaining formal independence in the early eighteenth century, finding large and statistically significant abnormal returns to holders of equity associated with this event.

The option for choosing a jury trial is another important distinctive feature of common law systems. The jury trial affects flexibility by providing a mechanism for community standards on appropriate behavior to influence trail verdicts. Even though jury trials occur in only a small fraction of private disputes, traditions of the jury trial are embedded in litigation under common law systems.[4] In a jury trial considerable importance attaches to the preparation for trial by legal counsel, through means such as discovery. The trial is an oral hearing that continues without

4. In England only criminal cases involving serious crimes to which the defendant pleads "not guilty" continue to be settled by jury trial. In the U.S., not more than 2% or 3% of potential personal injury cases are litigated to a trial-court judgment, according to estimates cited by Speiser, Krause, and Gans (1983, p. 10). That only a small fraction of injury cases are litigated presumably applies in most if not all countries, ones using civil as well as common law systems.

interruption, as the members of the jury cannot be subject to repeated recalls.[5]

In contrast, proceedings under civil law systems often take the form of a series of step-by-step sessions in which the judge learns the facts and arguments of the parties to the dispute (See Zweigert and Kötz, 1998, pp. 271–75). The judge takes an active role in questioning witnesses and in formulating issues in the case. Glendon, Gordon, and Osakwe (1994, p. 167) attribute these differences to the absence of a jury of private citizens in civil law countries. A common law jury trial requires a group of ordinary citizens to convene, to consider all of the evidence, and to apply the law. As a consequence, the trial must be continuous and uninterrupted. The absence of a jury in a civil law trial allows the proceedings to be drawn out over a longer period.[6]

The standard of proof for claims in disputes between private parties is a third distinctive feature that could affect flexibility. Under common law systems private claims must be proven by a preponderance of the evidence.[7] By contrast, in criminal cases the defendant must be proven guilty beyond a reasonable doubt. Under civil law systems the standard of proof

5. In criminal trials under civil law systems, courts typically include lay judges who sit alongside professional judges. Even though civil law courts do not use a jury of ordinary citizens, the lay judges, who may be elected, are a functional analog of the jury (see Glendon, Gordon, and Osakwe, 1994, p. 179). Private disputes in countries using civil law systems typically are heard by only a professional judge, although parties to the dispute usually have a right to appeal the court decision.

6. Djankov et al. (2003) find that resolution of commercial disputes is more formalized in civil law (especially French civil law) countries as compared to common law countries and in less developed as compared to richer countries. Within civil law countries, they find German and Scandinavian systems to be least formalized and French systems to be the most formalized. Their study examines the consequences of formalism for several measures of judicial quality, finding that more formalism is associated with longer duration of the dispute resolution process; lower judicial efficiency; greater corruption; lower levels of honesty, consistency, and fairness of the court system; and inferior access to justice.

7. Demougin and Fluet (2002) use a mechanism design framework to show formally that a common law type of negligence rule with "preponderance of evidence" standard is the only general rule for assessing liability that has minimal informational requirements to establish liability and also minimizes the sum of accident prevention costs and expected accident costs, which creates incentives for optimal investment in accident prevention identified by Posner (1972). Their finding holds even when parties to a dispute have unequal access to evidence and can distort information.

in private disputes is virtually indistinguishable from criminal cases: the judge or judges must be convinced beyond a reasonable doubt that the alleged facts are true and covered by statute. Sherwin and Clermont (2002) examine historical reasons for this difference and offer explanations for its persistence.

Additionally, civil code systems typically apply a strict liability standard to private injury claims, whereas common law systems further require the injured party to show that the actions of the defendant exposed the plaintiff to unreasonable risk that was foreseeable by a prudent person. In determining whether the risk is unreasonable, the fact finder weighs the utility of the act against the gravity of the potential harm. The question is not causation, and it never arises until causation is established (see Keeton et al., 1984, pp. 169–73, 280–300). Goldberg (2003a) clarifies this issue by arguing that negligence requires a finding of wronging, where the defendant's carelessness causes harm in a "natural" sequence of events that a prudent defendant could foresee.

A literal interpretation of these doctrines suggests that civil code systems can create incentives against acts that might lead to harm, and can do so without considering the cost of preventive efforts or whether a prudent person could have foreseen the harm. Common law systems create incentives against acts that might expose others to unreasonable risk, with reasonableness being determined by the weighing of potential harm against the utility of the act and the foreseeability of the harm. Under a common law system, failure to exercise a preventive measure can be defended by showing that the connection between the measure and the harm is remote or that the measure's cost outweighs the expected harm, while such arguments would be less persuasive under a civil code system. The structure of incentives under common law systems would be expected to focus efforts of rational individuals on preventive efforts that are cost-effective, a focus that would not be as strongly encouraged under civil code systems. Moreover, changes in the technology of accident prevention are likely to result in standards of cost-effectiveness evolving with the passage of time, making flexibility a legal system feature essential for addressing this issue.

The test results in section 4 can be interpreted as evidence on the adaptability of common law and civil code legal systems. The data are on accidental deaths in two groupings, the first of which is "motor vehicle accidents." For this first group an understanding of the linkage between

behavior and possible injury has been growing through a century of experience. Because the linkage between behavior and possible injury is well understood in this area, the extensive experience would allow the development of specific laws and regulations that would be effective in controlling behavior likely to cause injury or death, and a common law system would have no special advantage over a civil code system using a well-engineered body of rules and regulations.

The second group is "accidents other than motor vehicle," a more diffuse group that includes causes of death as diverse as other transport accidents, medical misadventures, accidental poisonings, accidents caused by machinery, and accidents caused by firearms. The diverse nature of this second group increases the difficulty of designing a system of rules and regulations specifying possibly harmful acts ex ante. For this second group of accidents, the flexibility of courts under common law systems to interpret concepts of negligence as they might apply to circumstances in a particular factual situation could create appropriate incentives where specific rules and regulations are not present. Whether these incentives are effective is an empirical question.

3. Data and Overview of Methodology

The hypothesis underlying tests in section 4 is whether countries' legal systems deter acts that could lead to harm. This question is tested indirectly with cross-country data on fatality rates from motor vehicle accidents and from accidents other than motor vehicle, as in Cummins, Phillips, and Weiss (2001), and Cohen and Dehejia's (2004) use of fatality rates to study effects of no-fault automobile compensation systems. Fatality rates are an objective gauge for assessing deterrence. With other measures, such as injury rates or economic cost, the legal system could have an effect that is not necessarily related to the harm caused by the incident. Fatality rates capture a substantial element of the economic costs of accidents because death typically is associated with serious accidents, constituting a major, if not the most significant, aspect of the economic burden from the accident.

Table 1 summarizes sources of information and time period covered in the data. The origin of countries' legal systems is based on La Porta et al. (1998), Reynolds and Flores (1989), and the U.S. Central Intelligence

Table 1. Sources of Information, Time Period, and Number of Countries Covered by Data

Nature of Data	Sources of Information	Years Covered	Number of Countries
Classification of countries' legal systems	La Porta et al. (1998), Reynolds and Flores (1989), *World Factbook.*		113
Accident fatality rates	WHO Mortality Database	1950–1999	Varies by year
Passenger vehicles in use	U.N. *Statistical Yearbook*	1950–1999	Varies by year
Economic Development (proxy; GNI, current U.S. dollars)	World Bank (2001) *WDI*	1962–1999	Varies by year

Agency's *World Factbook.*[8] Annualized accident fatality rates for each of the 113 countries were calculated from data for years 1950–1999 or, if fewer, for years in this interval where data were reported. Data on population and number of deaths by cause were extracted from detailed data files in the World Health Organization (WHO) Mortality database (2002), which is part of the WHO statistical information system (WHOSIS) on the WHO Web site. Data on motorized passenger vehicles in use for the years 1980–1999 were obtained from the CD-ROM version of the United Nations *Statistical Yearbook* (2001), while data for 1950–1979 were obtained from the print version of the same publication.[9] The proxy for economic development is gross national income (GNI) in current U.S. dollars, obtained from the CD-ROM version of the World Bank's *World Development Indicators* (WDI; 2001). Because of missing observations, test results never include all 113 countries.

8. Countries' legal systems are classified into five groups based on origin of legal system: four civil code systems based on French, German, Scandinavian, and Socialist law; and a fifth based on English common law. Socialist civil code countries include former members of the Soviet Union and Eastern Bloc countries as a single group. Insufficient mortality data were available covering countries with legal systems based on Islamic law to include the group in the study. The mortality data in the WHO statistical information system cover only a single Islamic law country, for a total of nine years during the period 1973–1985.

9. Data on passenger vehicles rather than total vehicles were used because of better data availability. The United Nations and WHO are not responsible for the conclusions in this study, which are the result of the author's analysis of the data.

Estimated means of fatality rates by legal system and year are graphed in Figures 1–3, as calculated from data on population, vehicle count, and deaths by cause. The fatality rates are per 100,000 persons and, in the case of vehicles, per thousand passenger vehicles. The data allow grouping of causes into motor vehicle accidents and other accidents because these groupings appear across all International

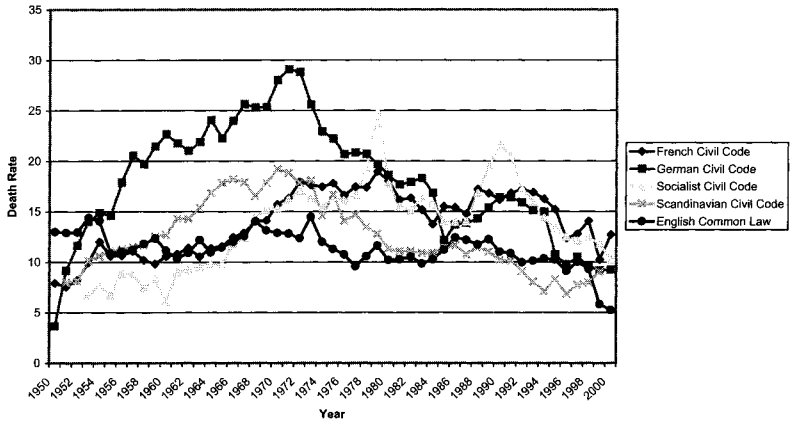

Figure 1. Motor Vehicle Accident Deaths Per 100,000 Persons (Means Across Countries Within Legal Systems).

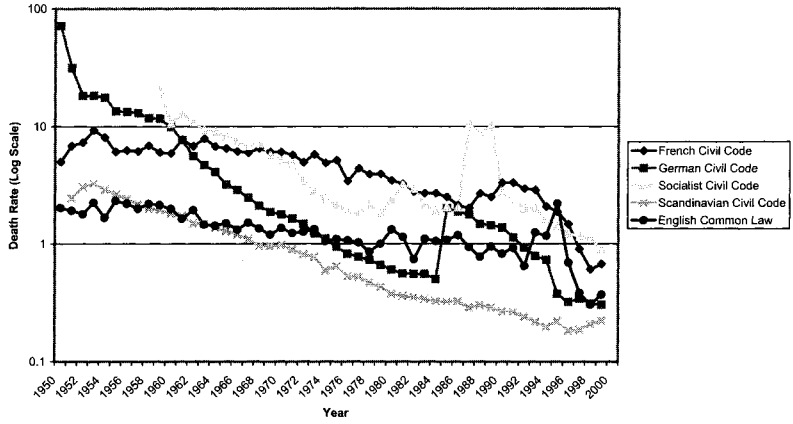

Figure 2. Motor Vehicle Accident Deaths Per Thousand Passenger Vehicles (Means Across Countries Within Legal Systems).

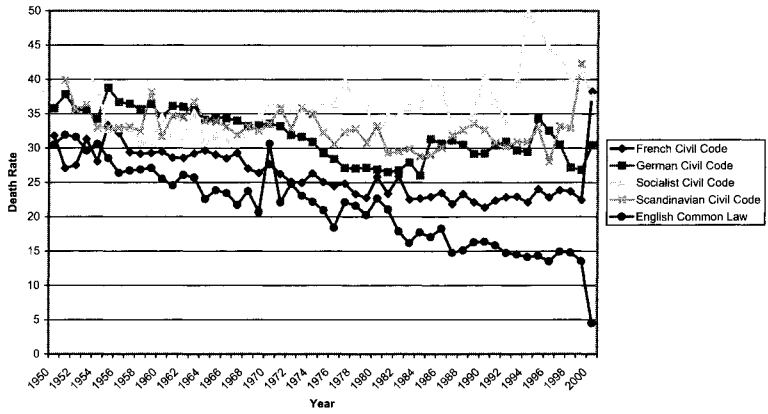

Figure 3. Deaths Per 100,000 Persons From Accidents Other Than Motor Vehicle (Means Across Countries Within Legal Systems).

Classification of Diseases (ICD) coding systems employed by countries during 1950–1999.[10]

The graphs in Figures 1, 2, and 3 provide background for the formal tests that appear in section 4. The data graphed in Figures 2 and 3 suggest differences between legal systems that show strong persistence over time, although observed differences should be interpreted with consideration that the number of observations for some legal systems and some years is small, especially near the beginning and end of the sample period. A notable feature of Figure 1 is high motor vehicle accident fatality rates for German civil code countries between 1956 and 1976. Also, data graphed in Figure 1 show less persistence than those in Figure 2, despite both figures' being based on motor vehicle accident fatality rates. Since Figure 1 illustrates fatality rates relative to population, while Figure 2 illustrates fatality rates relative to vehicles, patterns of vehicle usage can help to explain differences between the two figures.[11]

10. The ICD coding system is used to code causes of death for WHO reports. During the period 1950–1999, five ICD systems were in use: ICD 6, ICD 7, ICD 8, ICD 9, and ICD 10. In general, higher-numbered systems offering finer distinctions were adopted later in the period, although points of adoption differed across countries.

11. Typically, data on motor vehicle accident rates are reported relative to population or relative to a measure of vehicle usage. Table No. 1092 of the 2001 Statistical Abstract of the United States (p. 684) reports motor vehicle accident death rates per 100,000 resident population, per 100,000 licensed drivers, per 100,000 registered vehicles, and per 100 million vehicle-miles. Data used for tests in Section 4 of this paper allow estimation of death rates relative to population and vehicles in use but not vehicle-miles.

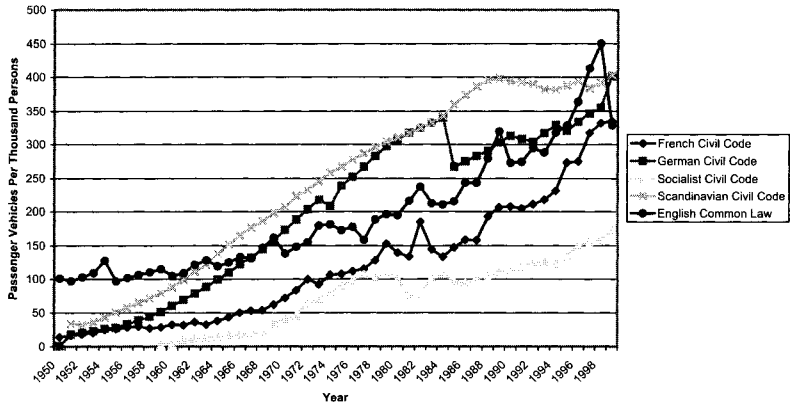

Figure 4. Passenger Vehicles Per Thousand Persons In Countries and Years Where Data Allows Calculation of A Death Rate Per Thousand Passenger Vehicles (Means Across Countries Within Legal Systems).

Major shifts in vehicle ownership and usage occurred between 1950 and 1999, and patterns of vehicle usage differed between legal systems. Vehicle usage patterns are illustrated in Figure 4, which graphs passenger vehicles in use per thousand persons across countries classified by origin of legal system. Vehicle usage shows an upward trend in all legal systems. For example, vehicles per thousand persons in common law countries rose to about 450 in 1998 from about 100 in 1950, approximately a 4.5-fold increase. By comparison, the increase in civil law countries is more dramatic, because these countries began with a much smaller base. Vehicles per thousand persons in the French civil code countries, for example, rose to about 335 in year 1999 from about 13.7 in 1950, a more than 24-fold increase.[12]

4. Results

Origin of Legal System and Motor Vehicle Accident Fatality Rates

Exposure to motor vehicle accidents is jointly related to both vehicles and population; in essence, a country's motor vehicle accident fatality rate

12. Figures 2-4 and, to a lesser extent, Figure 1 show abrupt changes in year 1985 for German civil code systems. These changes, which accompany the entry of data from a country previously not reporting (South Korea), are noticeable because the number of countries adopting German civil code systems is small.

Table 2. Motor Vehicle Accident Fatalities, Number of Passenger Vehicles, Population and GNI; ICD, Legal System and Year Fixed Effects (without Controlling for Economic Development)

	Full Period	Subperiods				
	1950–1999	1950–1959	1960–1969	1970–1979	1980–1989	1990–1999
Number of countries	102	43	59	72	86	71
Number of observations	2,393	270	489	514	603	517
Intercept: common law	−3.10***	−3.08***	−2.66***	−2.61***	−3.73***	−4.40***
	1(−8.16)	(−6.91)	(−4.48)	(−6.05)	(−9.79)	(−9.17)
French civil code dummy	0.50***	0.54***	0.63***	0.67***	0.42**	0.39*
	(5.17)	(4.07)	(3.77)	(4.92)	(3.35)	(2.29)
German civil code dummy	0.50***	0.93***	0.79***	0.42*	0.24	0.31*
	(4.46)	(6.44)	(4.87)	(2.52)	(0.98)	(2.01)
Socialist civil code dummy	0.75***	0.78*	0.86***	0.64***	0.64***	0.57***
	(6.73)	(2.55)	(4.02)	(4.30)	(5.07)	(3.85)
Scand. civil code dummy	0.09	0.27	0.22	0.03	0.01	−0.06
	(0.60)	(1.93)	(1.26)	(0.18)	(0.07)	(−0.31)
Log passenger vehicles (000)	0.36***	0.47***	0.46***	0.42***	0.27***	0.12
	(9.31)	(11.51)	(7.46)	(7.45)	(5.17)	(1.88)
Log population (00)	0.67***	0.61***	0.57***	0.59***	0.77***	0.91***
	(13.85)	(11.32)	(6.50)	(9.27)	(13.11)	(11.58)
Other fixed effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year
r^2	.93	.97	.94	.95	.94	.91

Notes: Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log number of motor vehicle accident fatalities. The explanatory variable is origin of legal system, with log number of passenger vehicles (in thousands), log population (in hundreds), ICD coding system, and fixed year effects as control variables. The left-hand column reports test results from the longest time period for which observations are available; columns to the right report tests on data from ten-year subperiods. Countries' legal systems were coded as zero-one dummy variables with a variable for English common law countries omitted. Coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English common law countries. Years and ICD reporting systems are coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. The *t*-statistics, which are reported in parentheses, are based on heteroscedasticity-consistent standard errors adjusted for the lack of independence within observations on the same country over time.

*$p < .05$.

**$p < .01$.

***$p < .001$.

Table 3. Motor Vehicle Accident Fatalities, Number of Passenger Vehicles, Population and GNI; ICD, Legal System and Year Fixed Effects (Controlling for Economic Development)

	Full Period	Subperiods			
	1962–1999	1962–1969	1970–1979	1980–1989	1990–1999
Number of countries	88	46	55	65	69
Number of observations	1,569	249	403	444	476
Intercept: common law	−4.55**	−8.25**	−9.10**	−7.70**	−3.87*
	(−3.11)	(−3.52)	(−3.55)	(−3.39)	(−2.59)
French civil code dummy	0.53***	0.59**	0.58***	0.49***	0.44**
	(4.86)	(3.00)	(4.22)	(3.77)	(2.99)
German civil code dummy	0.43**	0.63**	0.26	0.29	0.30*
	(2.94)	(3.09)	(1.15)	(1.10)	(2.11)
Socialist civil code dummy	0.91***	—	—	0.70***	0.56**
	(5.25)	—	—	(4.16)	(3.07)
Scand. civil code dummy	−0.06	−0.11	−0.28	−0.09	−0.07
	(−0.42)	(−0.49)	(−1.61)	(−0.56)	(−0.42)
Log GNI	0.10	0.45*	0.46**	0.25	−0.03
	(1.29)	(2.66)	(2.90)	(1.94)	(−0.34)
Log passenger	0.28**	0.23	0.11	0.12	0.15
vehicles (000)	(3.44)	(1.96)	(0.80)	(1.01)	(1.68)
Log population (00)	0.63***	0.29	0.41***	0.67***	0.91***
	(10.05)	(1.92)	(5.26)	(9.78)	(12.00)
Other fixed effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year
r^2	.93	.94	.94	.94	.93

Notes: Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log number of motor vehicle accident fatalities. The explanatory variable is origin of legal system, with log number of passenger vehicles (in thousands), log population (in hundreds), log GNI (in hundreds of contemporaneous U.S. dollars), ICD coding system, and fixed year effects as control variables. The left-hand column reports test results from the longest time period for which observations are available; columns to the right report tests on data from ten-year subperiods. Countries' legal systems were coded as zero-one dummy variables with a variable for English common law countries omitted. Coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English common law countries. Years and ICD reporting systems are coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. The *t*-statistics, which are reported in parentheses, are based on heteroscedasticity-consistent standard errors adjusted for the lack of independence within observations on the same country over time.

*$p < .05$.

**$p < .01$.

***$p < .001$.

per 100,000 persons tends to increase with the number of motor vehicles operated in the country. Tables 2 and 3 report tests on cross-country data according to a model that gauges exposure by combining population and

vehicle usage.[13] The issue being tested is the effect of legal system, with controls for other effects. The dependent variable is log motor vehicle accident fatalities, and the predictor variable is legal system, with log number of passenger vehicles, log population, log GNI, fixed year effects, and ICD coding system effects serving as control variables.[14] The tests employ a between-cluster estimator of variance based on very general assumptions that allows for arbitrary dependence among observations within a given country and heteroscedasticity between countries, using a technique based on a Huber (1967) and White (1980) robust variance estimator.[15] The fixed year effects make the tests equivalent to pooled cross-sectional tests based on each legal system's deviation from the average for that year. Because the issue being tested is cross-sectional, test statistics on the year and ICD dummy variables convey no useful information and are not reported.

13. Data on passenger-miles could substitute for the combined population and vehicle count measure of exposure, but data on passenger-miles are available for few countries.

14. The control for ICD coding system captures the effect of changes in medical reporting conventions. This model specification is a reasonably good fit to the data, but changing the model specification does not notably affect test results. As one check on robustness, nearly identical levels of significance for legal system effects (and the same signs, where significant) were obtained with use of log motor vehicle accident death rate per 100,000 persons as the dependent variable and by changing the vehicle exposure and economic development control variables to, respectively, log passenger vehicles per 1,000 persons and log per capita GNI. This approach to structuring the tests may appear to be a natural way to conduct the experiment, but the per capita measures result in the population variable's appearance on both sides of the regression equation, possibly inducing spurious correlation. As another check on robustness, nearly identical but somewhat weaker levels of significance (and the same signs, where significant) were obtained when fixed time effects and ICD coding effects were not included in the model.

15. Williams (2000) offers a proof that the robust between-cluster variance estimator is unbiased under very general assumptions for cluster-correlated data where observations are correlated within countries (clusters) but uncorrelated between countries. Williams also notes that this estimator is not well documented in the literature despite its being well known and offering a wide range of applicability. Analyses that do not correct for dependence within clusters are likely to underestimate true variance. In the test results presented in Tables 2–5 of this paper, reported *t*-statistics are reduced substantially (generally, reduced by about one-half) from those obtained with a standard fixed effects model that does not consider clustering of data.

Tests reported in Table 2 do not control for economic development; those reported in Table 3 control for economic development, using GNI in U.S. dollars as a proxy. Controlling for the effects of economic development sharply reduces the number of observations, especially in earlier time intervals. Despite the WDI's offering the most extensive cross-country data on economic development the author was able to identify, WDI reports no GNI data for time periods before 1962, and availability afterward is limited.

GNI tends to be strongly correlated with number of passenger vehicles across countries and over time, resulting in GNI and passenger vehicle count being close empirical substitutes. Despite the statistical correlation, economic development is a broader measure that captures other important issues, such as levels of medical care and quality of roads. Thus, the tests reported in Table 3 reflect more complete controls for variables likely to affect vehicle fatality rates, while tests reported in Table 2 reflect more complete data and include earlier time periods.[16]

Each column of Tables 2 and 3 shows estimated coefficients in a regression across countries classified by origin of legal system. The left-hand column of each table reports tests using all available data, with columns to the right reporting tests on data from subperiods. Legal systems, years, and ICD coding systems were coded as zero-one dummy variables, with omitted variables for English common law countries, the earliest year in the period, and the ICD coding system most frequently used in common law countries during the period.[17] Thus the intercept term includes estimated death rates in English common law countries at the beginning of the period. Coefficients for legal system dummy variables

16. Tests in Table 2 show the number of passenger vehicles to be a strong predictor of motor vehicle accident deaths in all periods except 1990–1999. By 1990–1999 the number of passenger vehicles per capita no longer varies enough across countries classified by legal system to offer the predictive power observed in earlier periods (see Figure 4). Also, the inclusion of log GNI as a predictor variable in Table 3 causes the significance of passenger vehicles to vanish except in tests for the entire 1962–1999 time period. Similar effects appear when a model employing GNI alone as a predictor is compared to a model using both passenger vehicles and GNI.

17. On tests covering the longest time interval covered in the data, the ICD 7 dummy variable was omitted for tests on 1962–1999 data controlling for GNI (Table 3) while the ICD 6 dummy variable was omitted in tests for 1950-1999 without the GNI control (Table 2).

other than common law are estimates of the incremental effect of the legal system relative to an English common law country with the same population, vehicle count, and, in Table 3, GNI. For example, the coefficient 0.53 for French civil code countries for 1962–1999 in Table 3 implies a point estimate of their geometric mean fatality rate that is $e^{0.53} = 1.70$ times as great as in a comparable English common law country.

Whether or not GNI is included as a control, estimates in Tables 2 and 3 show motor vehicle accident fatalities in French and Socialist civil code countries exceeding those in comparable common law countries, in most cases at very strong ($p < .001$) levels of significance. These differences are evident for tests on all available data, as well as for tests on ten-year subperiods. Although the point estimates of fatality rates under French and Socialist civil code systems decline relative to common law systems after 1980, they still remain significantly above those in common law countries during 1990–1999.[18]

In tests using all available data and for periods before 1970, motor vehicle accident fatality rates in German civil code countries are significantly higher than in common law countries. In the tests reported in Table 2 that do not control for GNI, fatality rates in German civil code countries are significantly higher for 1970–1979, as well. In early periods the differences are substantial. For example, the coefficient 0.63 for German civil code countries for 1962–1969 in Table 3 implies a point estimate of their geometric mean fatality rate that is $e^{0.63} = 1.88$ times as great as comparable English common law countries. The tests in both tables show a pattern: initially, fatality rates under German systems are higher than under common law systems, declining until the difference becomes insignificant in 1980–1989, and later rising to again become significantly higher

18. Tests in Table 3 were repeated without controlling for GNI but limiting observations to those where GNI is reported (i.e., tests based on identical observations but not using log GNI as a control). None of the significant tests on civil code systems changed sign, and levels of significance were affected only slightly. One of the coefficients for civil code dummies declined one level of significance, while two increased one level. One insignificant coefficient changed sign and remained insignificant. These results suggest that differences between Tables 2 and 3 are due primarily to the observations considered in developing the estimates (i.e., whether estimates of GNI are available for the country) rather than to the effect of controlling for GNI. Another possible explanation is that the differences are due to unobserved changes that accompany the reporting of GNI data to the World Bank.

during 1990–1999. However, the late increase accompanies the entry of data from South Korea, which began reporting in 1985 and had a large effect due to the small sample size (seven countries) for German systems (see note 12).[19] When tests were repeated without data from South Korea, the difference between death rates in German civil code and common law countries for 1990–1999 became insignificant. With this qualification in the background, a conservative conclusion would be that death rates under German systems initially were higher than under common law systems but later declined until differences became insignificant. For Scandinavian civil code countries, motor vehicle accident fatality rates do not differ significantly from those in common law countries, a conclusion that applies to all available data and to any subperiod.

With respect to the comparison of English common law to French and German civil code systems, the pattern of estimates in Tables 2 and 3 for recent periods mirrors that found by La Porta et al. (1998) and other researchers in the law-and-finance literature when one tests the effect of legal systems on the development of financial markets.[20] Also, low observed fatality rates in Scandinavian civil code countries introduces new aspects of what Stulz and Williamson (2003) describe as a "Scandinavian Puzzle" discovered by Nenova (2000), who found values for corporate control rights in Scandinavian countries that are about as low as in common law countries. This finding was reaffirmed in Dyck and Zingales's (2004) tests even after they controlled for extralegal mechanisms, such as the rate of tax compliance and circulation of daily newspapers. Despite the civil code structure and origins of Scandinavian legal systems, motor vehicle accident fatality rates and the value of private corporate control rights under these systems are about as low as (and possibly lower than) they are under common law systems.

Origin of Legal System and Fatality Rates from Accidents Other Than Motor Vehicle

Tables 4 and 5 offer additional evidence on legal systems' creation of incentives against possibly harmful acts, using data on fatalities from

19. Also, the reunification of formerly separated East and West Germany took place in 1990.

20. La Porta et al.'s 1998 study did not include Socialist civil code countries, which are considered in a later study on the quality of government (La Porta et al. 1999).

Table 4. Number of Deaths from Accidents Other Than Motor Vehicle, Population and GNI; ICD, Legal System and Year Fixed Effects (without Controlling for Economic Development)

	Full Period	Subperiods				
	1950–1999	1950–1959	1960–1969	1970–1979	1980–1989	1990–1999
Number of countries	105	45	63	82	84	67
Number of observations	2,487	295	521	622	562	487
Intercept: common law	−3.71***	−4.14***	−4.35***	−3.69***	−4.01***	−4.41***
	(−21.66)	(−10.07)	(−21.79)	(−16.97)	(−16.55)	(−16.46)
French civil code dummy	0.21*	0.07	0.15	0.17	0.29**	0.41**
	(2.49)	(0.60)	(1.74)	(1.75)	(2.72)	(3.04)
German civil code dummy	0.44**	0.23	0.31*	0.38*	0.64*	0.60***
	(3.06)	(1.88)	(2.05)	(2.21)	(2.50)	(3.85)
Socialist civil code dummy	0.65***	0.19	0.29***	0.59***	0.78***	0.95***
	(6.61)	(1.65)	(3.87)	(5.45)	(5.02)	(5.95)
Scand. civil code dummy	0.49***	0.30*	0.40***	0.49***	0.78**	0.67***
	(5.07)	(2.18)	(3.77)	(4.07)	(3.36)	(4.50)
Log population (00)	1.01***	1.05***	1.05***	0.99***	1.00***	1.02***
	(61.69)	(30.73)	(57.95)	(48.48)	(44.08)	(42.61)
Other fixed effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year
r^2	.96	.97	.97	.97	.95	.95

Notes: Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log number deaths from accidents other than motor vehicle. The explanatory variable is origin of legal system, with log population (in hundreds), ICD coding system, and fixed year effects as control variables. The left-hand column reports test results from the longest time period for which observations are available; columns to the right report tests on data from ten-year subperiods. Countries' legal systems were coded as zero-one dummy variables with a variable for English common law countries omitted. Coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English common law countries. Years and ICD reporting systems are coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. The *t*-statistics, which are reported in parentheses, are based on heteroscedasticity-consistent standard errors adjusted for the lack of independence within observations on the same country over time.

*$p < .05$.
**$p < .01$.
***$p < .001$.

Table 5. Number of Deaths from Accidents Other Than Motor Vehicle, Population and GNI; ICD, Legal System and Year Fixed Effects (Controlling for Economic Development)

	Full Period	Subperiods			
	1962–1999	1962–1969	1970–1979	1980–1989	1990–1999
Number of countries	85	46	59	66	63
Number of observations	1,601	253	443	469	436
Intercept: common law	−4.29***	−5.24***	−5.31***	−4.46***	−3.71***
	(−8.06)	(−8.85)	(−8.99)	(−5.76)	(−4.24)
French civil code dummy	0.31**	0.32**	0.21*	0.38**	0.33*
	(3.31)	(3.36)	(2.10)	(3.12)	(2.61)
German civil code dummy	0.48*	0.39*	0.25	0.58*	0.54***
	(2.65)	(2.15)	(1.11)	(2.07)	(3.94)
Socialist civil code dummy	1.04***	—	—	1.04***	0.91***
	(6.68)	—	—	(4.37)	(4.96)
Scand. civil code dummy	0.62***	0.46**	0.46***	0.77**	0.71***
	(5.09)	(3.60)	(4.37)	(3.19)	(4.45)
Log GNI	0.04	0.09	0.13*	0.03	−0.05
	(0.91)	(1.67)	(2.43)	(0.46)	(−0.82)
Log population (00)	0.97***	0.95***	0.88***	0.97***	1.08***
	(18.27)	(13.81)	(14.39)	(12.20)	(14.11)
Other fixed effects	ICD, Year	ICD, Year	ICD, Year	ICD, Year	ICD, Year
r^2	0.96	0.97	0.97	0.95	0.96

Notes: Each column of this table shows estimated coefficients in a regression across countries classified by origin of legal system. The dependent variable is log number deaths from accidents other than motor vehicle. The explanatory variable is origin of legal system, with log population (in hundreds), log GNI (in hundreds of contemporaneous U.S. dollars), ICD coding system, and fixed year effects as control variables. The left-hand column reports test results from the longest time period for which observations are available; columns to the right report tests on data from ten-year subperiods. Countries' legal systems were coded as zero-one dummy variables with a variable for English common law countries omitted. Coefficients for legal system dummy variables other than common law are estimates of the log difference between that system's fatality rate and the rate for English common law countries. Years and ICD reporting systems are coded as zero-one dummy variables to take into account year-to-year variation and changes in medical reporting conventions as fixed effects. Tests on these year and ICD dummies are not reported. The *t*-statistics, which are reported in parentheses, are based on heteroscedasticity-consistent standard errors adjusted for the lack of independence within observations on the same country over time.

*$p < .05$.

**$p < .01$.

***$p < .001$.

accidents other than motor vehicle. The pattern of organization in Tables 4 and 5 is similar to the one used in Tables 2 and 3 for motor vehicle accidents. The issue being tested is the effect of legal system, with controls for other effects. The dependent variable is log number of fatalities from accidents other than motor vehicle, and the predictor variable is legal system, with log population, log GNI, fixed year effects, and ICD coding

system effects serving as control variables.[21] The tests employ the between-cluster estimator of variance used in Tables 2 and 3. Test statistics on the year and ICD dummy variables are not reported. Table 4 reports test results without controlling for the level of economic development; results in Table 5 control for economic development, using GNI in U.S. dollars.

The left-hand column of each table reports tests using all available data, with columns to the right reporting tests on data from subperiods. In each column the estimated intercept includes the death rate in English common law countries at the beginning of the period. Coefficients for legal system dummy variables other than common law are estimates of the incremental effect of the legal system relative to an English common law country with the same population and, in Table 5, GNI. For example, the coefficient 0.31 for French civil code countries for 1962–1999 in Table 5, controlling for GNI, implies a point estimate of their geometric mean fatality rate that is $e^{0.31} = 1.36$ times as great as in a comparable English common law country.

Tests using all available data reported in the left-hand column of each table show death rates in civil code countries that are significantly higher than in common law countries, in most cases at strong ($p < .01$) or very strong ($p < .001$) levels of significance. These differences appear, whether or not the GNI control is used. Tests for subperiods reveal a disparity between civil code and common law systems that grows over time, both in the magnitude of the difference and the level of its significance. The disparity is especially evident for Scandinavian and Socialist civil code countries; the result for Scandinavian countries is surprising, given the small sample size for Scandinavian systems. The differences are substantial; the coefficient 0.71 for Scandinavian civil code countries for 1990–1999 in Table 5, controlling for GNI, implies a point estimate of their

21. As in the earlier tests on motor vehicle accidents, this model specification offers a reasonably good fit to the data, although test results are not especially affected by model specification. Nearly identical levels of significance for legal system effects (and the same signs, where significant) were obtained with use of the death rate per 100,000 persons as the dependent variable and by changing the control variable for economic development to per capita GNI. Under this approach, the per capita measures result in the population variable's appearance on both sides of the regression equation, possibly inducing spurious correlation.

geometric mean fatality rate that is $e^{0.71} = 2.03$ times as great as in a comparable English common law country. Visual evidence on this issue appears in Figure 3, the graphs of average fatality rates by legal system and year.[22] Except for the Socialist civil code countries, this visual evidence does not suggest that death rates in civil code countries increased, but rather that they failed to decrease as rapidly as in common law countries.

5. Conclusion

This study presents evidence that fatalities from causes whose likelihood of occurrence is affected by the degree of care vary significantly between countries classified by origin of legal system. The tests are patterned after the law-and-finance literature, and the results to a large extent mirror and reinforce the growing acceptance of legal systems as an important factor affecting incentives against behavior that might lead to harm. The long period of time covered in the data allow tests not only for differences between legal systems, but also for the evolution of these differences over time.

Test results in Tables 2 and 3 show automobile accident fatality rates to be higher under French and Socialist systems than under common law systems, for all comparison periods. Fatality rates under German systems are high during early periods but later converge with those under common law systems. Automobile accident fatality rates under Scandinavian systems do not differ significantly from those under common law systems, either for any subperiod, or for all available data.

These findings in Tables 2 and 3 for automobile accident fatality rates could be interpreted as evidence of changing levels of safety in vehicle or road design, an interpretation that requires safety levels to grow at

22. Tests in Table 5 were repeated without controlling for GNI but with limitation of observations to those where GNI is reported. The resulting changes in significance for civil code systems were minor. None changed sign. Two of the coefficients for civil code dummies increased one level of significance, while one previously significant at the 5% level became insignificant (at $p < .08$). These results suggest that differences between Table 4 and Table 5 are due primarily to the observations considered in developing the estimates rather than the effect of controlling for GNI. As noted for this type of robustness check for Tables 2 and 3, another possible explanation is the differences are due to unobserved changes that accompany the reporting of GNI data to the World Bank.

different rates across legal systems. Somewhat more plausibly, the findings could evince the adaptability of common law, German, and Scandinavian systems as compared to French and Socialist systems. The findings also could be due to effects of specific regulations applying to motor vehicle operation, which presumably grew over time under all legal systems. Under this interpretation, the Scandinavian systems always had, and the German systems eventually were able to develop, specific regulations that create deterrence incentives as strong as those under common law systems. The French and Socialist systems never were able to develop regulations creating incentives this strong, although the tendency in later subperiods for estimated death rates under French and Socialist systems to decline in comparison to those under common law systems is evidence of growing effectiveness. Without necessarily rejecting other conclusions, the evolution over time of automobile accident death rates under Scandinavian, German, and common law systems supports a conclusion that a well-engineered civil code system can provide incentives deterring possibly harmful acts if the types of possibly harmful behaviors and the process by which they lead to harm are well understood.

Changes in levels of safety or effects of specific regulation offer less satisfactory explanations for the findings in Tables 4 and 5 on deaths from accidents other than motor vehicle. The causes of death in this category are too diverse to be captured in even a well-designed system of specific codes and regulations, which can explain why these tests offer no evidence that the Scandinavian and German systems are adaptable. The disparity between civil code and common law systems that grows over time supports a conclusion that adaptability of common law systems creates ever-growing incentives against harmful acts. The data suggest that civil code systems have not created comparable incentives, especially where possible causes of harm are too diffuse to be specified ex ante in regulations.

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